

(19) World Intellectual Property Organization
International Bureau



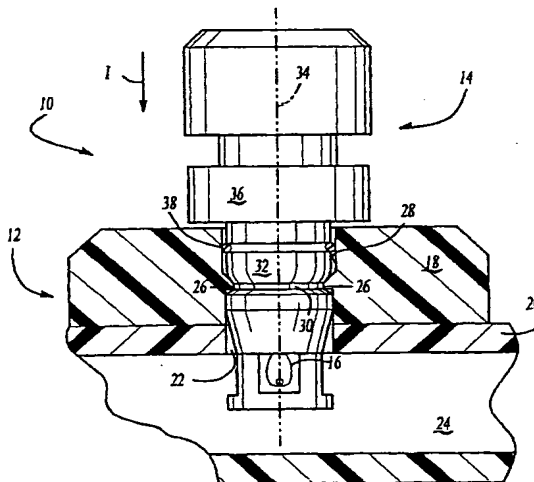
(43) International Publication Date
19 April 2001 (19.04.2001)

PCT

(10) International Publication Number
WO 01/27564 A1

- (51) International Patent Classification⁷: G01D 11/30, (72) Inventor: DALY, Paul, D.; 2166 Joanne, Troy, MI 48084 (US).
B29C 65/56
- (21) International Application Number: PCT/CA00/01201 (74) Agent: MACRAE & CO.; P.O. Box 806, Station B, Ottawa, Ontario K1P 5T4 (CA).
- (22) International Filing Date: 12 October 2000 (12.10.2000) (81) Designated States (*national*): CZ, HU, JP, MX.
- (25) Filing Language: English (84) Designated States (*regional*): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
- (26) Publication Language: English
- (30) Priority Data: 60/159,414 14 October 1999 (14.10.1999) US
Published:
— With international search report.
- (71) Applicant: SIEMENS CANADA LIMITED [CA/CA]; 16 Industrial Park Road, Tilbury, Ontario N0P 2L0 (CA).
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CREEP ENHANCED SENSOR ATTACHMENT ARRANGEMENT



(57) Abstract: A vehicle sensor assembly (10) includes a vehicle sensor (14) of a relatively low density material assembly for a vehicle fluid directing component (12) such as an air intake manifold having a sensor receipt member (18) formed of a relatively high density material. When the sensor (14) is inserted into the sensor receipt member (18), the relatively softer sensor engagement surface (30) is displaced from its free state by the relatively harder sensor receipt member engagement surface (26). The relatively softer sensor engagement surface (30) is resilient and will always attempt to return to its free state position to relieve the high stress area. In attempting to return to its free state, the sensor engagement surface (30) will "creep" toward a low stress area. The sensor body (14) responds by "creeping" toward the vehicle fluid directing component. The present invention thereby takes advantage of the relief of residual stresses formed during insertion of the sensor body (14) to tighten the mounting of the sensor into the vehicle fluid directing component (12).

CREEP ENHANCED SENSOR ATTACHMENT ARRANGEMENT

BACKGROUND OF THE INVENTION

The present invention relates to a vehicle sensor, and more particularly to a sensor attachment arrangement for vehicle fluid directing component which provide an enhanced retention force over time.

Various types of air induction components such as air induction manifolds, air filter assemblies and throttle bodies are used in the field of internal combustion engines. Many known air induction components are presently manufactured of a non-metallic material such as nylon to simplify fabrication and reduce weight.

The prevalence of substantially non-metallic air induction components can create difficulties for the installation of sensors such as temperature sensors, manifold absolute pressure (MAP) sensors, mass air flow sensors, potentiometers and the like. Such sensors are commonly threaded directly into apertures in the air induction components. Other sensors include extended tabs which receive threaded fastener that enter the air induction components. During use over time, however, the air induction component heats up and the threaded sensor or fastener may tend to move away from its installed position. The sensor may then shift away from its original position and cause a degradation of performance.

Another known sensor attachment arrangement includes a barb which snaps onto a ledge. However, the known barb and ledge is relatively easy to disengage. A measure of a snap fit is the locking ratio which can be defined as the force to put the snap-fit in, divided by the force to take the snap fit object out. The locking ratio for the known barb arrangement is approximately 1:2. That is, it only requires approximately twice as much force to remove the barb as to insert it. A low locking retention ratio is particularly disadvantageous when located adjacent a high-vibration vehicle component.

Known sensor attachment arrangements are also typically unique for each particular sensor. The unique attachment arrangements complicate manufacture of the air induction component and increases the difficulties of substituting sensors for different vehicle and engine types.

Other known uses include provisions for creep in the attachment arrangement of toys. Typically, a barb and ledge or bayonet arrangement are provided on plastic toys which increase in retention force over time. However, the known toy attachment arrangements types are still relatively easy to disengage because of the simplified engagement arrangement.

Accordingly, it is desirable to provide a sensor assembly which can be easily, securely and inexpensively attached to a non-metallic fluid directing component and which provides an enhanced retention force as residual stresses formed during insertion are relieved. It is further desirable to provide a generic attachment arrangement to simplify manufacture of the air induction component and allow the interchangeability of sensors.

SUMMARY OF THE INVENTION

The present invention provides a vehicle sensor assembly of a relatively low density material for a vehicle fluid directing component such as an air intake manifold having a sensor receipt member formed of a relatively high density material. The sensor assembly includes a sensor engagement surface such as groove in a locating segment of the sensor. The sensor engagement surface defines an outer periphery dimension and a sensor receipt member engagement surface defines an inner periphery dimension which is of a smaller diameter than the free state outer diameter of the sensor engagement surface. Because the sensor engagement surface is larger than the sensor receipt member engagement surface, an interference fit is preferably established when the sensor is inserted into the sensor receipt member.

When the sensor is inserted into the sensor receipt member, the relatively softer sensor engagement surface is displaced from its free state by the relatively harder sensor receipt member engagement surface. A high stress area is thereby formed in the sensor adjacent the sensor engagement surface. As the sensor is inserted into the sensor receipt member in a particular direction the high stress area will substantially form on the side of the sensor engagement surface opposite the direction of insertion. The relatively softer sensor engagement surface is resilient and will always attempt to return to its free state position to relieve the high stress area. In attempting to return to its free state, the sensor engagement surface will "creep" toward a low stress area.

Over a period of time, the "creep" from high stress area to the low stress area will tend to displace the sensor engagement surface relative to the sensor receipt member engagement surface. This movement will increase in rate if the sensor engagement surface is exposed to heat. Accordingly, the sensor body will respond by "creeping" toward the vehicle fluid directing component. The present invention thereby takes advantage of the relief of residual stresses formed during insertion of the sensor body to tighten the mounting of the sensor into the vehicle fluid directing component.

BRIEF DESCRIPTION OF THE DRAWINGS

The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows:

Figure 1 is a general sectional view of a sensor assembly and associated vehicle fluid directing component designed according to the present invention;

Figure 2 is an expanded sectional view illustrating the engagement member; and

Figure 2A is an expanded schematic view illustrating the high stress area formed adjacent the engagement surface and displacement thereof.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 illustrates an exploded view of a vehicle sensor assembly 10 and a vehicle fluid directing component 12 such as an air intake manifold. The fluid directing component 12 is preferably manufactured of a non-metallic material such as glass filled nylon, PET, LCP, PPC, PBT or various other relatively hard or high density plastics. The sensor assembly 10 includes a sensor body 14 to retain a sensor element 16 such as temperature sensors, manifold absolute pressure (MAP) sensors, mass air flow sensors, potentiometer or other sensor element. The sensor body 14 is preferably manufactured of a non-metallic material such as polypropylene or various other relatively soft or low density plastics.

A sensor receipt member 18 is preferably formed into the vehicle fluid directing component 12 such as an air intake manifold. As illustrated in Figure 1, the sensor receipt member 18 extends from an external wall 20 of the fluid directing component 12

and provides an aperture 22 into the interior 24 of the fluid directing component 12. The sensor receipt member 18 preferably includes an engagement surface 26 such as a circumferential ridge 26 which extends inwardly from an inner wall 28 of the aperture 22.

5 The sensor 10 includes a sensor engagement surface 30 such as groove 30 in a locating segment 32 of the sensor body 14. The locating segment 32 fits within the aperture 26 along a first axis 34. A sensor body segment 36 extends from the locating segment 32 and is preferably fabricated as a cylinder having a diameter greater than the locating segment 32.

10 A seal 38 such as an O-ring is fitted to the locating segment 32. After assembly, the seal 38 is under compression between the sensor locating segment 32 and the inner wall 28 to assure an air-tight fit of the sensor body 14 in the fluid directing component 12. Although a radial seal is illustrated, it should be understood that other seal configurations and locations can be used, such as a face seal adjacent the body segment
15 36.

 The sensor engagement surface 30 defines an outer periphery dimension. The sensor receipt member engagement surface 26 defines an inner periphery dimension that is of a smaller diameter than the free state outer diameter of the sensor engagement surface 30. Because the sensor engagement surface 30 is larger than the sensor receipt
20 member engagement surface 26, an interference fit is preferably established when the sensor 14 is inserted into the sensor receipt member 18 (illustrated by arrow I).

 Referring to Figure 2, an expanded view of the sensor engagement surface 30 engaged with the sensor receipt member engagement surface 26 is illustrated. When the sensor 14 is inserted into the sensor receipt member 18 (arrow I), the relatively softer
25 sensor engagement surface 30 is displaced from its free state by the relatively harder sensor receipt member engagement surface 26. A high stress area (illustrated schematically at 40) is thereby formed in the sensor body 14 adjacent the sensor engagement surface 30. As the sensor 14 is inserted into the sensor receipt member 18 in the direction of arrow I, the high stress area 40 will substantially form on the side of the
30 sensor engagement surface 30 in the direction of insertion I.

 The relatively softer sensor engagement surface 30 is resilient and will always attempt to return to its free state position to relieve the high stress area 40. In attempting

to return to its free state, the sensor engagement surface 30 will "creep" toward a low stress area (illustrated schematically at 42). The stress in the high stress area 40 will move in the direction of insertion C from the high stress area 40 toward the low stress area 42 (illustrated schematically by arrow C in Figure 2A). Over a period of time, the "creep" from high stress area 40 to the low stress area 42 will tend to displace the sensor engagement surface 30 relative to the sensor receipt member engagement surface 26. This movement will increase in rate if the sensor engagement surface 30 is exposed to heat.

Accordingly, the sensor body 14 will respond by "creeping" in the insert mount direction I along the first axis 34. Over time, the sensor body 14 will thereby further seat itself into the sensor receipt member 18. In other words, instead of loosening from the mounted position, the present invention takes advantage of the relief of residual stresses formed during insertion of the sensor body 14 to tighten the engagement between the sensor engagement surface 30 and the sensor receipt member engagement surface 26.

The foregoing description is exemplary rather than limiting in nature. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, one of ordinary skill in the art would recognize that certain modifications are possible that would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. For that reason the following claims should be studied to determine the true scope of protection given for this invention.

CLAIMS

1. A sensor assembly for a vehicle fluid directing component comprising:
a sensor receipt member formed of a first material, said sensor receipt
5 member including an aperture having an engagement surface; and
a sensor body formed of a second material having a density less than said
first material, said sensor body insertable into said aperture in a first direction such that
an area of increased stress is produced adjacent said engagement surface, said area of
increased stress substantially relievable in a second direction over a period of time.
10
2. The sensor assembly as recited in claim 1, wherein said engagement
surface extends toward an interior of said aperture.
3. The sensor assembly as recited in claim 1, wherein said engagement
15 surface includes a circumferential ridge.
4. The sensor assembly as recited in claim 1, wherein said area of increased
stress includes a compressive stress.
- 20 5. The sensor assembly as recited in claim 1, wherein said first material
includes a polypropylene material.
6. The sensor assembly as recited in claim 1, wherein said second material
includes a glass filled nylon material.
25
7. The sensor assembly as recited in claim 1, further including a seal
engagable with said sensor receipt member and said sensor body.
8. The sensor assembly as recited in claim 1, wherein said vehicle fluid
30 directing component includes a non-metallic intake manifold.

9. A sensor assembly for a vehicle fluid directing component comprising:
a sensor receipt member formed of a first material, said sensor receipt member including an aperture having a circumferential ridge, said circumferential ridge having an inner periphery dimension; and

5 a sensor body formed of a second material having a density less than said first material, said sensor body having a sensor engagement surface having a free state outer periphery dimension greater than said inner periphery dimension, said sensor body insertable into said aperture in a first direction such that said circumferential ridge interacts with said sensor engagement surface to form an area of increased stress adjacent
10 said circumferential ridge.

10. The sensor assembly as recited in claim 8, wherein said area of increased stress includes a compressive stress.

15 11. The sensor assembly as recited in claim 8, said area of increased stress substantially relievable in a second direction over a period of time.

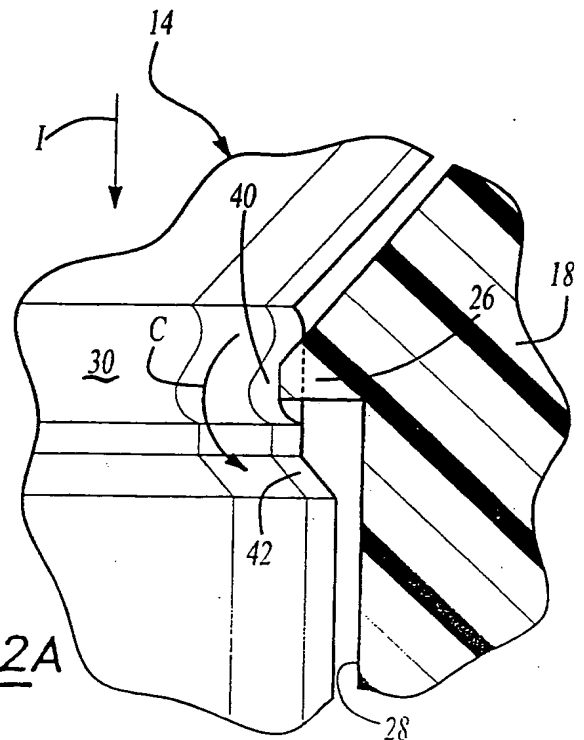
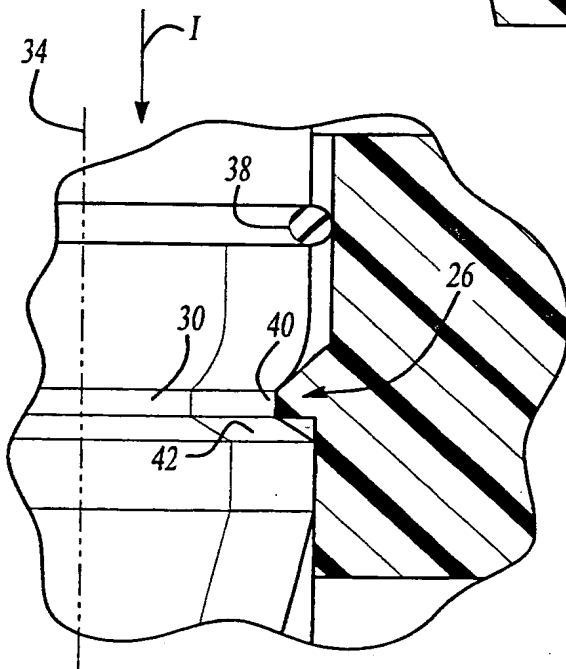
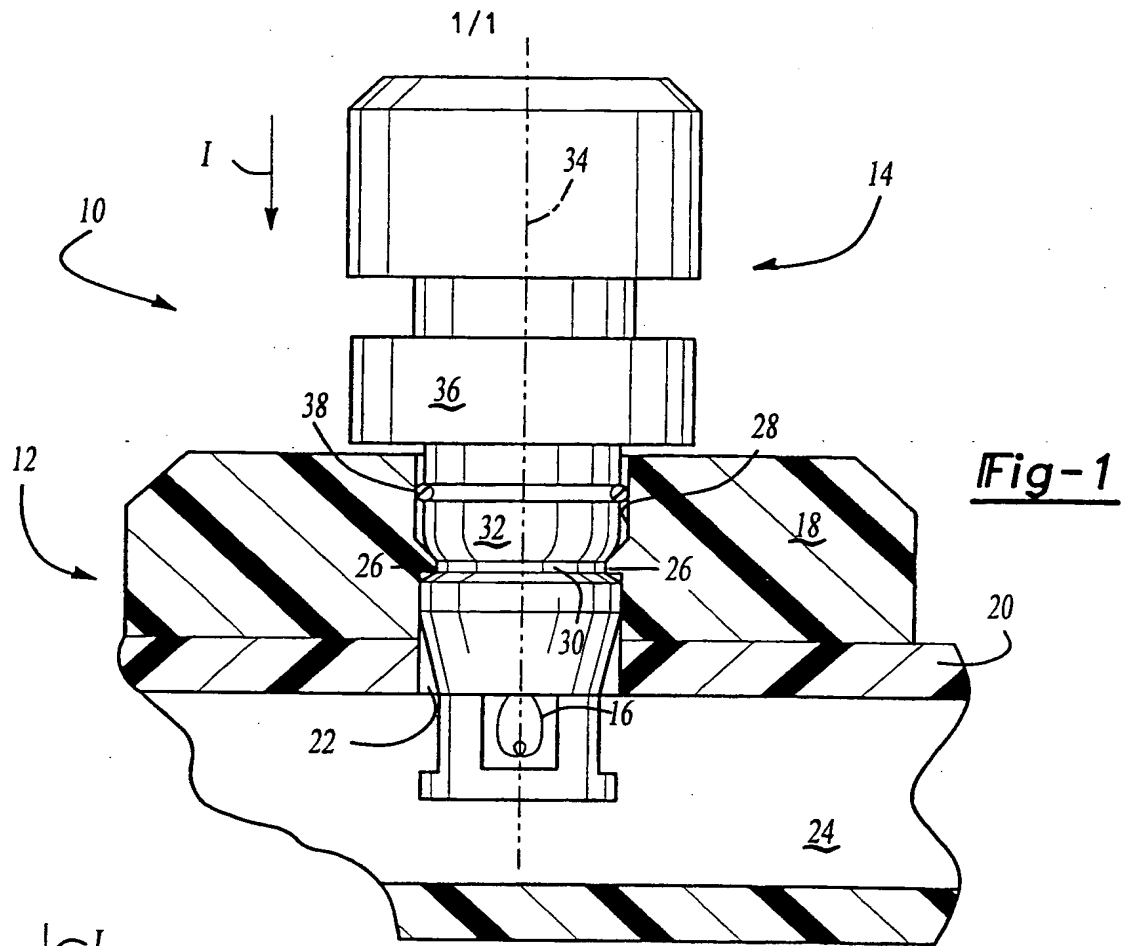
12. The sensor assembly as recited in claim 8, wherein said first material includes a polypropylene material.

20

13. The sensor assembly as recited in claim 8, wherein said second material includes a glass filled nylon material.

14. The sensor assembly as recited in claim 8, further including a seal
25 engagable with said sensor receipt member and said sensor body.

15. A method of mounting a sensor assembly comprising the steps of:
- (1) forming a sensor receipt member of a first material;
 - (2) forming a sensor body of a second material having a density less than said first material and an engagement surface;
 - 5 (3) inserting the sensor body into the sensor receipt member in a first direction; and
 - (4) forming an area of increased stress adjacent the engagement surface.
- 10 16. A method as recited in claim 15, wherein said step (3) includes providing an interference fit between the sensor body into the sensor receipt member.
- 15 17. A method as recited in claim 15, wherein said step (4) includes forming the area of increased stress on a side of the sensor engagement surface substantially opposite the first direction.
- 20 18. A method as recited in claim 15, wherein said step (4) includes the relieving of the area of increased stress in a substantially second direction over a period of time such that the sensor body is substantially driven toward the sensor receipt member.
19. A method as recited in claim 18, wherein said second direction is substantially toward said first direction.



INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 00/01201

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G01D11/30 B29C65/56

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01D F16B B29C F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 678 063 A (JAEGER) 24 December 1992 (1992-12-24) page 1, line 1 - line 33 page 3, line 25 - line 29 page 4, line 6 - line 9; figures 1-5	1, 9, 15
A	FR 1 282 934 A (GROSSAUER) 15 June 1962 (1962-06-15) page 1, right-hand column, line 37 -page 2, left-hand column, line 13; figure 1	1-4, 9, 10, 14-17
A	DE 44 23 081 A (VDO) 4 January 1996 (1996-01-04) column 2, line 41 - line 48 column 2, line 28 - line 29 column 2, line 57 - line 65; figure 1	1, 9, 15
	-/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search

18 December 2000

Date of mailing of the international search report

22/12/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel: (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Joris, J

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 00/01201

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 692 352 A (ELECTRONSYSTEM) 17 December 1993 (1993-12-17) page 3, line 8 - line 16; figure 1	1,9,15
A	EP 0 204 969 A (FISCHER) 17 December 1986 (1986-12-17) column 2, line 4 - line 10 column 2, line 18 - line 32 column 3, line 10 - line 17 column 3, line 50 - line 53; figure 1	1,5,9,15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CA 00/01201

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
FR 2678063	A	24-12-1992	NONE	
FR 1282934	A	15-06-1962	NONE	
DE 4423081	A	04-01-1996	NONE	
FR 2692352	A	17-12-1993	NONE	
EP 204969	A	17-12-1986	CH 669025 A	15-02-1989
			AT 41989 T	15-04-1989
			AU 5841886 A	11-12-1986
			CA 1283934 A	07-05-1991
			CN 86103881 A,B	07-01-1987
			DE 3662722 D	11-05-1989
			DK 263786 A,B,	07-12-1986
			ES 296711 U	16-12-1987
			JP 61286693 A	17-12-1986
			US 4697831 A	06-10-1987

THIS PAGE BLANK